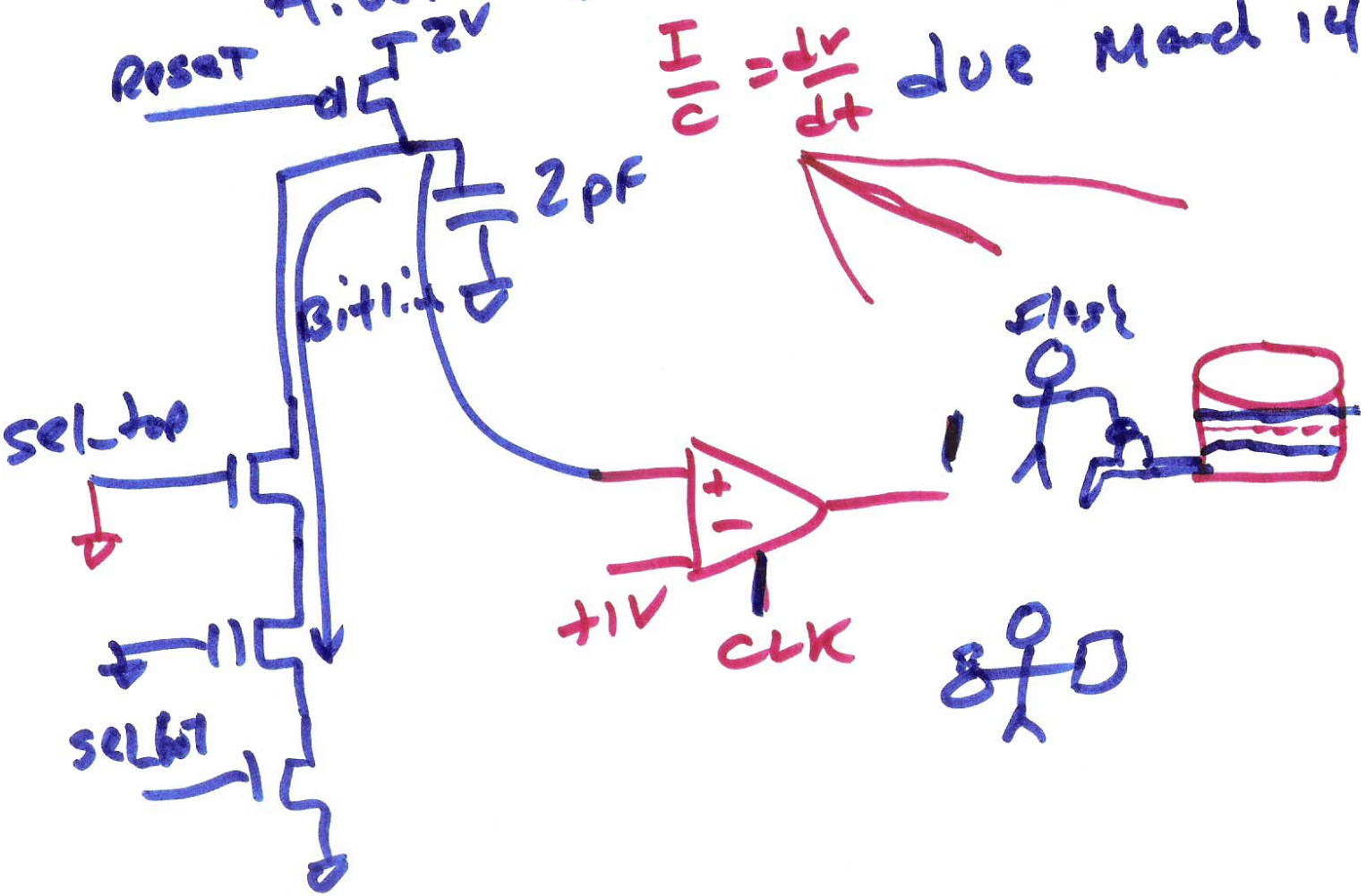
A17.1 & A17.2

Lecture 13, March 7, 2011

BOISE STATE UNIVERSITY

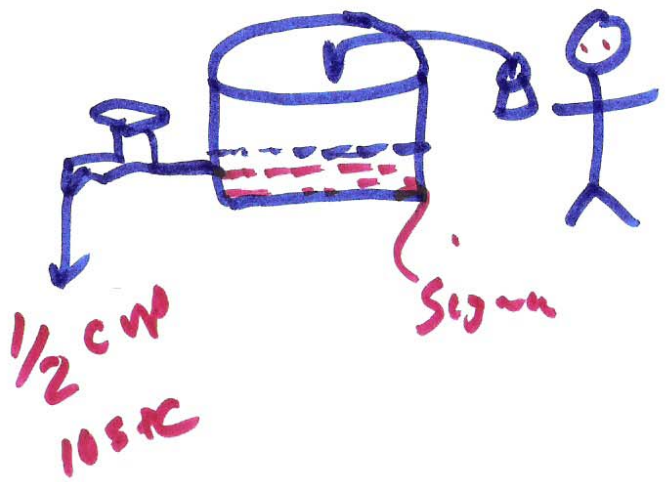
ECE 5/418 Memory CKT Design

H.W. # 10 A17.1 & A17.2 due March 14



$\frac{I}{C} = \frac{dv}{dt}$

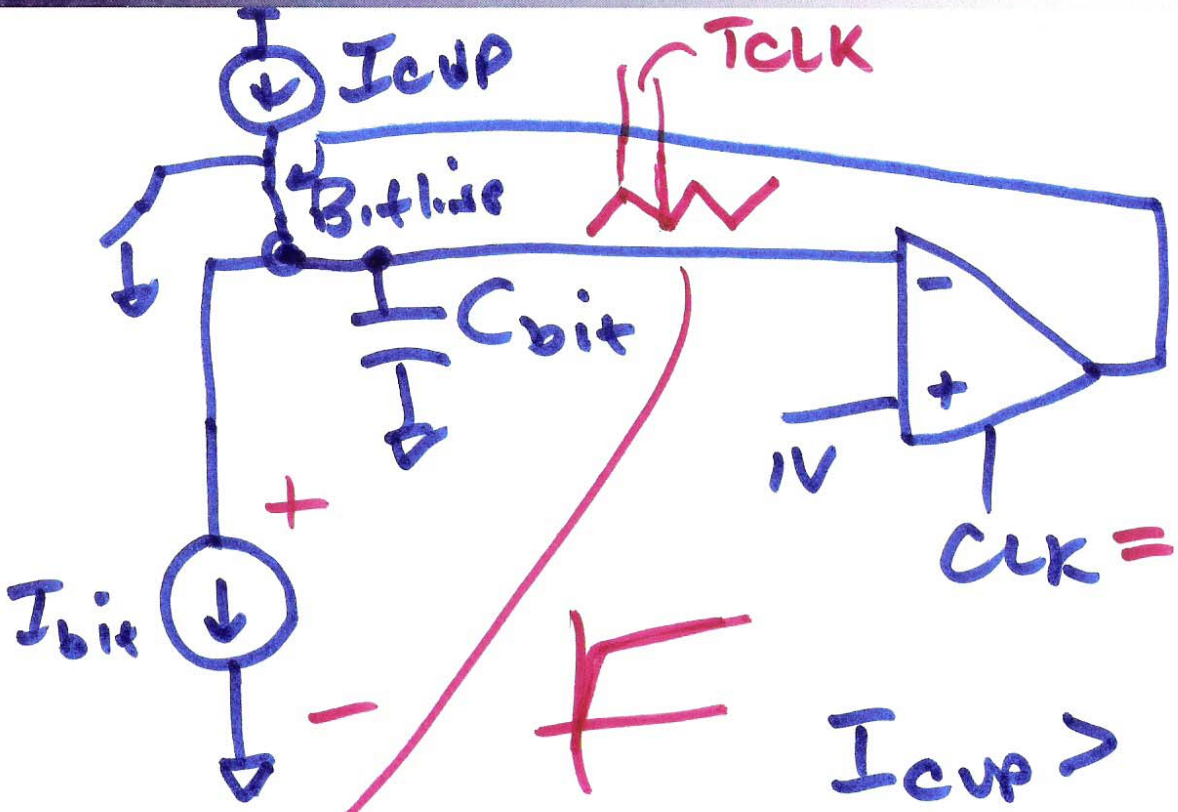
Delta –



time	ADD
0	1
10	0
20	1
30	0
40	0
50	1
60	1

1 cup · $\frac{50}{100}$ 100

2)



$$\frac{I}{C} = \frac{\Delta V}{\Delta T}$$

$$\frac{I}{C} \cdot \Delta T_{CLK} = \Delta V$$

$$CLK = f_{CLK} = \frac{1}{T_{CLK}}$$

F

$I_{CUP} > I_{bit}$

$$\Delta V_{bit}\Big|_{MAX} = \frac{I_{bit}^{MAX}}{C_{bit}} \cdot T_{CLK} \quad \text{OR} \quad \boxed{\frac{I_{CUP}}{C_{bit}} \cdot T_{CLK}}$$

N = total # of times we clock the cap.

M = # of output high times $\frac{M}{N} \cdot I_{CUP} = I_{bit}$

3)

$$I_{cup} \cdot \frac{M}{N} = I_{bit}$$

$$10\mu \cdot \frac{50}{100} = 5.1\mu$$

$N = 100$,

$I_{cup} = 10\mu A$

$I_{bit} = 5\mu A$

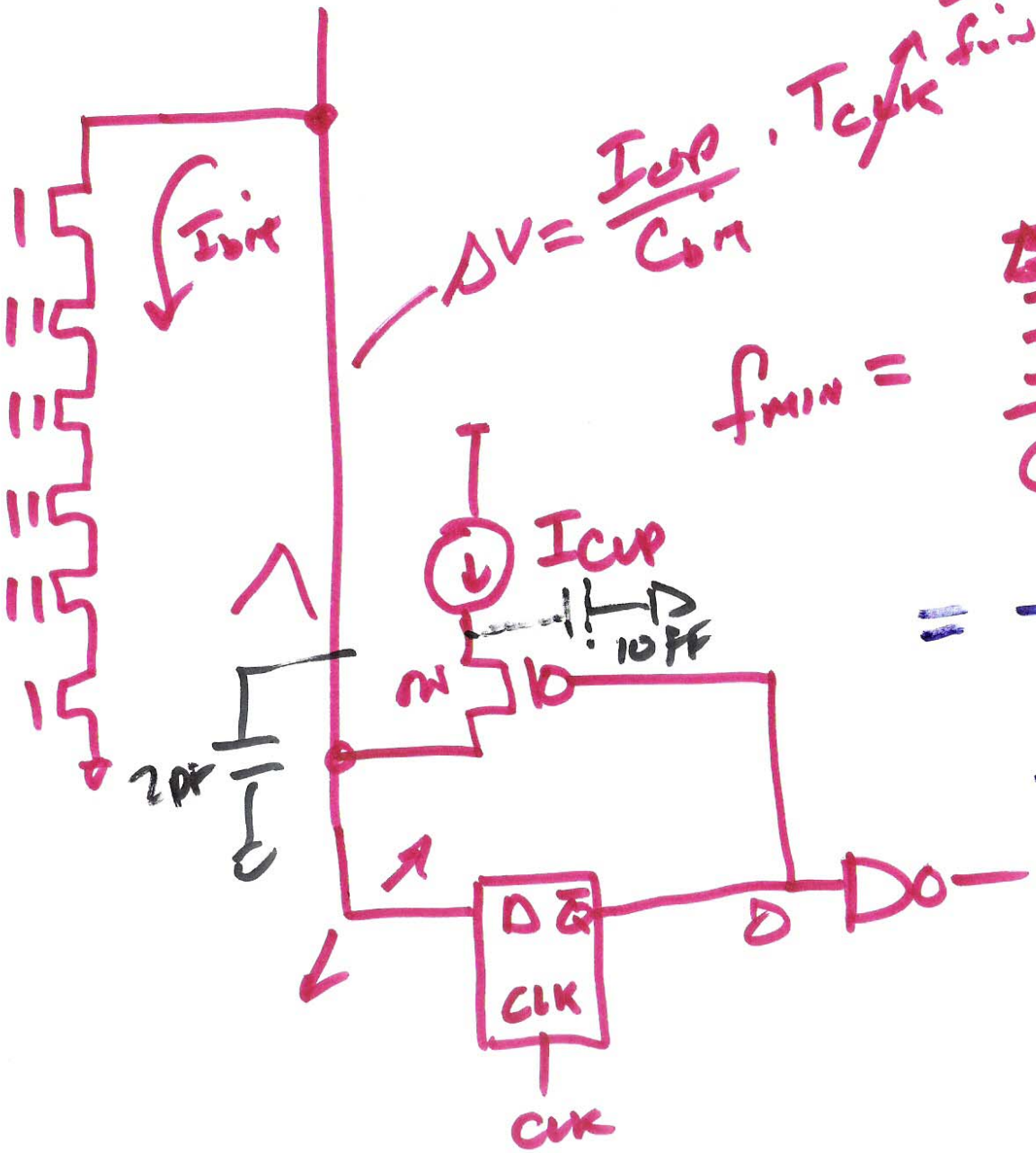
$M = 50$

Resolution $= .1\mu$

$$= \frac{10\mu}{100} = \frac{I_{cup}}{N} \quad I_{bit} = 5.1\mu A$$

$$\text{Res.} = \frac{I_{cup}}{N}$$

4)



$$\Delta V = \frac{I_{CUP}}{C_{bit}} \cdot T_{CLK} \quad T_{CLK} = \frac{1}{f_{MIN}}$$

$$f_{MIN} = \frac{I_{CUP}}{C_{bit} \cdot \Delta V_{MAX}}$$

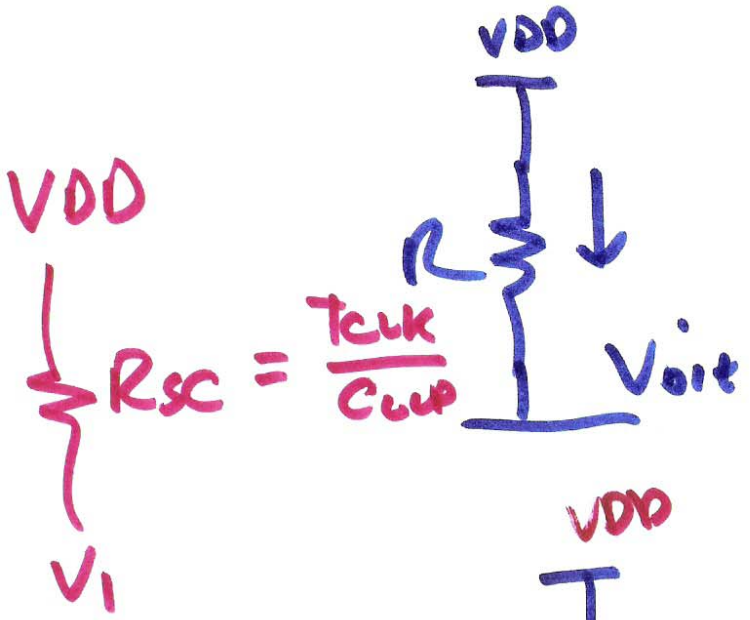
$$= \frac{10\,\mu}{2\,pF \cdot 250\,mV}$$

$$= \frac{10}{500} \cdot 10^9$$

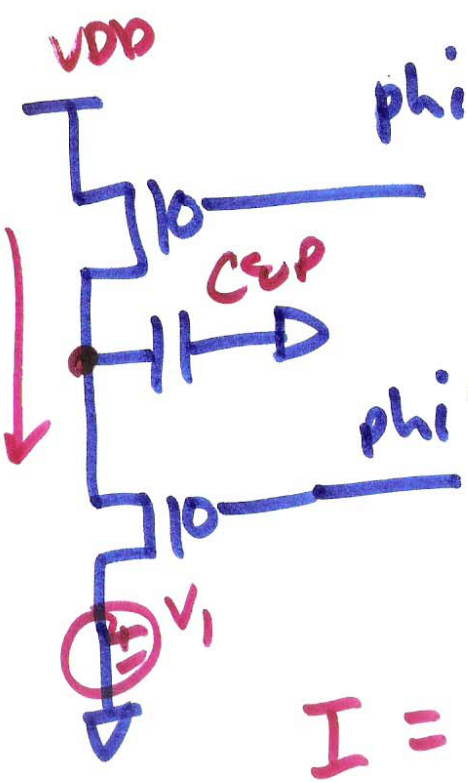
$$= \frac{1}{50} \cdot 10^9$$

$$= 20\ MHz$$

5)

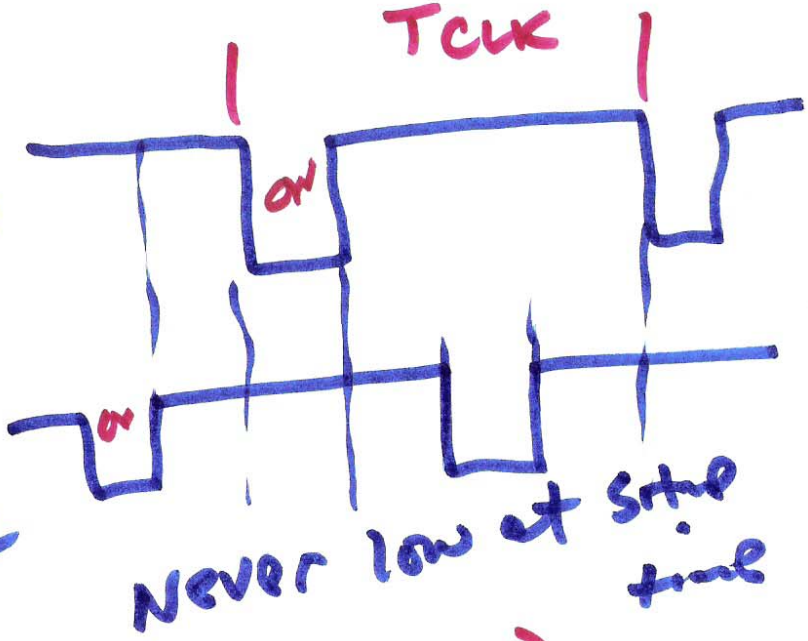


$$I = \frac{VDD - V_{out}}{R}$$



$C_{CUP} \cdot VDD -$

$C_{CUP} \cdot V_1$

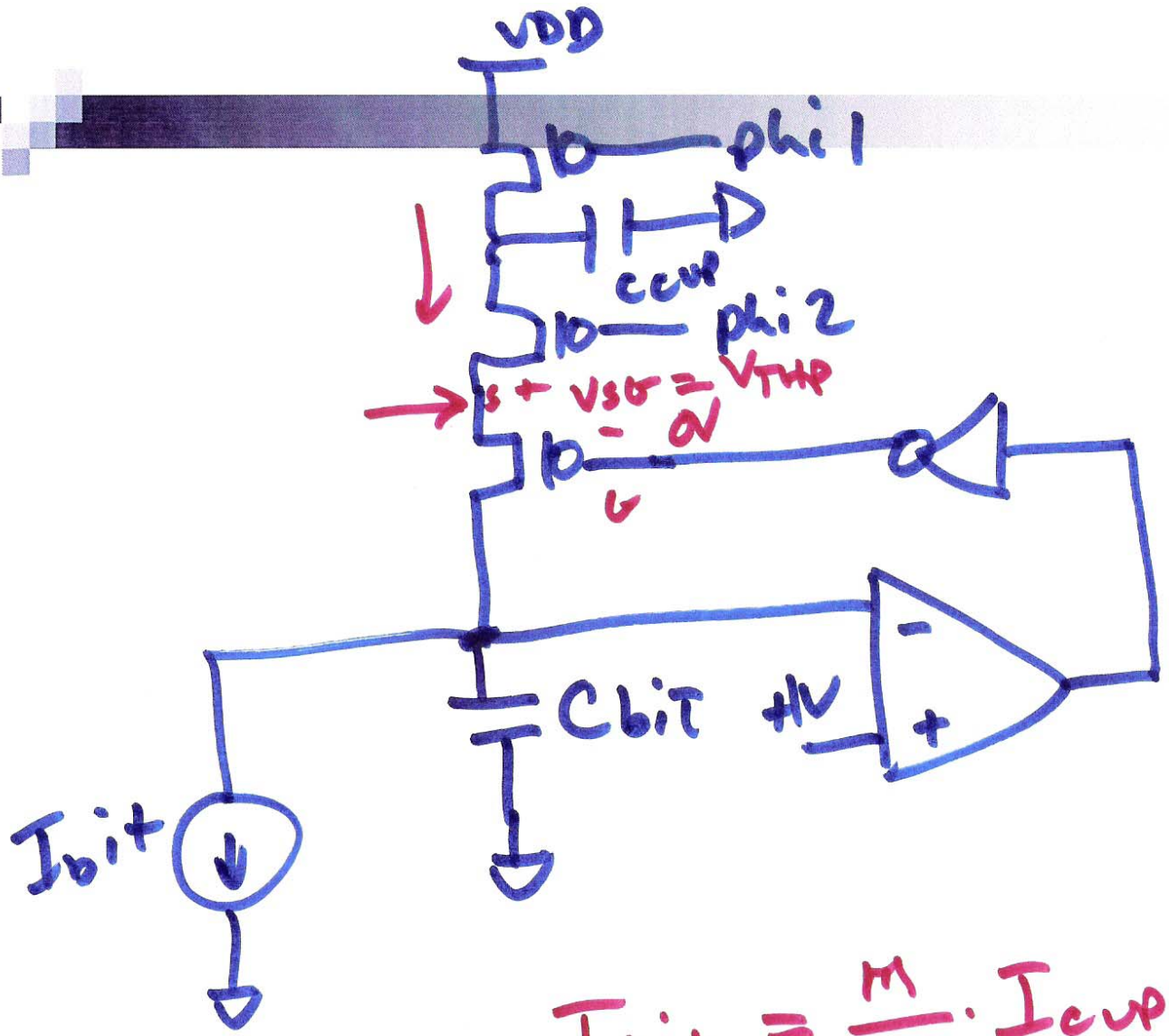


$$= \frac{1}{f_{CLK}}$$

$$I = \frac{C_{CUP}(VDD - V_1)}{TCLK}$$

$$= \frac{VDD - V_1}{R_{SC}} \Rightarrow R_{SC} = \frac{1}{f_{CLK} \cdot C_{UP}}$$

6)



N = # of clks

m = # of times comp output goes high

$$R_{SC} = \frac{T_{CLK}}{C_{comp}}$$

$$I_{bit} = \frac{M}{N} \cdot I_{comp}$$

$$I_{comp} = \frac{VDD - V_{THP}}{R_{SC}}$$